

Product Specification

SPECIFICATION FOR APPROVAL

(◆) Preliminary Specification
() Final Specification

| | |
|-------|-------------------|
| Title | 19.5" HD+ TFT LCD |
|-------|-------------------|

| | |
|-------|--|
| BUYER | |
| MODEL | |

| | |
|----------|----------------------|
| SUPPLIER | LG Display Co., Ltd. |
| *MODEL | LM195WD1 |
| SUFFIX | TLC1 |

*When you obtain standard approval,
please use the above model name without suffix

| APPROVED BY | SIGNATURE DATE |
|-------------|----------------|
| / | |
| / | |
| / | |

Please return 1 copy for your confirmation
with
your signature and comments.

| APPROVED BY | SIGNATURE DATE |
|--------------------------|----------------|
| B. C. Kim / G. Manager | |
| REVIEWED BY | |
| S. H . Kim /Manager [C] | |
| Y. H. Hwang /Manager [M] | |
| M. S. Kang /Manager [P] | |
| Y. G. Kang /Manager [O] | |
| REPAIRED BY | |
| J. H. Oh / Engineer | |

IT/Mobile Development Division 1
LG Display Co., Ltd

Product Specification

Contents

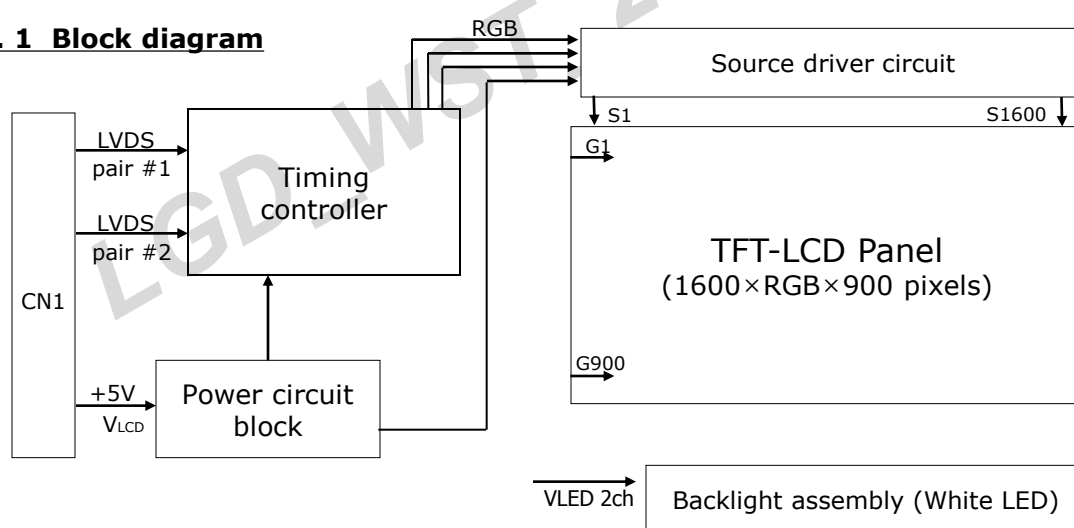
| No | ITEM | Page |
|----|---|------|
| | COVER | 1 |
| | CONTENTS | 2 |
| | RECORD OF REVISIONS | 3 |
| 1 | GENERAL DESCRIPTION | 4 |
| 2 | ABSOLUTE MAXIMUM RATINGS | 5 |
| 3 | ELECTRICAL SPECIFICATIONS | 6 |
| | 1) ELECTRICAL CHARACTERISTICS | 6 |
| | 2) INTERFACE CONNECTIONS | 8 |
| | 3) LVDS characteristics | 11 |
| | 4) SIGNAL TIMING SPECIFICATIONS | 14 |
| | 5) SIGNAL TIMING WAVEFORMS | 15 |
| | 6) COLOR INPUT DATA REFERNECE | 16 |
| | 7) POWER SEQUENCE | 18 |
| | 8) POWER DIP CONDITION | 19 |
| 4 | OPTICAL SFECIFICATIONS | 19 |
| 5 | MECHANICAL CHARACTERISTICS | 23 |
| 6 | RELIABILITY | 26 |
| 7 | INTERNATIONAL STANDARDS | 27 |
| | 1) SAFETY | 27 |
| | 2) EMC | 27 |
| | 3) ENVIRONMENT | 27 |
| 8 | PACKING | 28 |
| | 1) DESIGNATION OF LOT MARK | 28 |
| | 2) PACKING FORM | 28 |
| 9 | PRECAUTIONS | 29 |
| | 1) MOUNTING PRECAUTIONS | 29 |
| | 2) OPERATING PRECAUTIONS | 29 |
| | 3) ELECTROSTATIC DISCHARGE CONTROL | 30 |
| | 4) PRECAUTIONS FOR STRONG LIGHT EXPOSURE | 30 |
| | 5) STROAGE | 30 |
| | 6) HANDLING PRECAUTIONS FOR PROTECTION FILM | 30 |

Product Specification

1. General description

LM195WD1-TLC1 is a Color Active Matrix Liquid Crystal Display with an integral Light Emitting Diode(LED) backlight system. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive type display operating in the normally white mode. It has a 19.5 inch diagonally measured active display area with HD+ resolution (900 vertical by 1600 horizontal pixel array) Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 8-bit gray scale signal for each dot, thus, presenting a palette of more than 16.7M colors with Advanced-FRC(Frame Rate Control). It has been designed to apply the interface method that enables low power, high speed, low EMI. FPD Link or compatible must be used as a LVDS(Low Voltage Differential Signaling) chip. It is intended to support applications where thin thickness, wide viewing angle, low power are critical factors and graphic displays are important. In combination with the vertical arrangement of the sub-pixels, the LM195WD1-TLC1 characteristics provide an excellent flat panel display for office automation products such as monitors.

FIG. 1 Block diagram



General features

| | |
|------------------------|--|
| Active screen size | 19.5 inches (494.11mm) diagonal |
| Outline Dimension | 452.0(H) x 263.0(V) x 10.5(D) mm(Typ.) |
| Pixel Pitch | 0.2712*RGB(H)mm x 0.2626(V)mm |
| Pixel Format | 1600 horizontal By 900 vertical Pixels. RGB stripe arrangement |
| Interface | LVDS 2Port |
| Color depth | 16.7M colors |
| Luminance, white | 200 cd/m ² (Center 1Point, typ) |
| Viewing Angle (CR>10) | R/L 90(Typ.), U/D 50(Typ.) |
| Power Consumption | Total 12.02W(Typ.), (3.12 W@V _{LCD} , 8.9 W@I _{BL} = 120 mA) |
| Weight | 1,400 g (Typ.) |
| Display operating mode | Transmissive mode, normally White |
| Surface treatments | Hard coating (3H), Anti-glare treatment of the front polarizer |

Product Specification

2. Absolute maximum ratings

The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

Table 1. Absolute maximum ratings

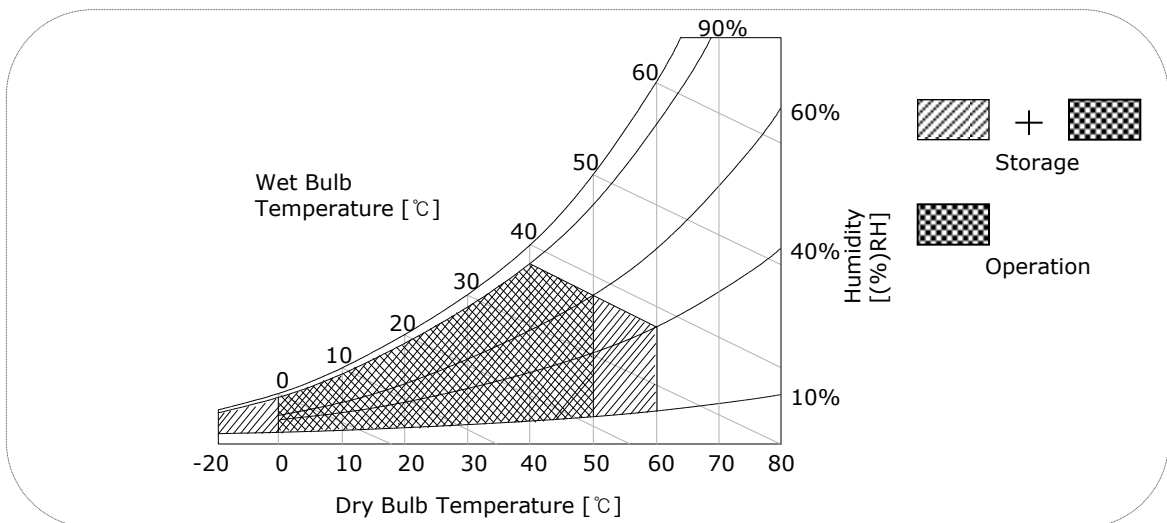
| Parameter | Symbol | Values | | Units | Notes |
|-------------------------------------|---------------|--------|------|-------|---------|
| | | Min | Max | | |
| Power Supply Input Voltage | V_{LCD} | -0.3 | +6.0 | Vdc | At 25°C |
| Operating Temperature | T_{OP} | 0 | 50 | °C | 1,2,3 |
| Storage Temperature | T_{ST} | -20 | 60 | °C | |
| Operating Ambient Humidity | H_{OP} | 10 | 90 | %RH | |
| Storage Humidity | H_{ST} | 10 | 90 | %RH | |
| LCM Surface Temperature (Operation) | $T_{Surface}$ | 0 | 65 | °C | 1, 4 |

Note : 1. Temperature and relative humidity range are shown in the figure below.

Wet bulb temperature should be 39 °C Max, and no condensation of water.

- Maximum Storage Humidity is up to 40°C, 90% RH only for 4 corner light leakage Mura.
- Storage condition is guaranteed under packing condition.
- LCM Surface Temperature should be Min. 0°C and Max. 65°C under the VLCD=5.0V, fV=60Hz, 25°C ambient Temp. no humidity control and LED string current is typical value.

FIG. 2 Temperature and relative humidity



Product Specification

3. Electrical specifications

3-1. Electrical characteristics

It requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second input power for the LED/Backlight, is typically generated by an LED Driver. The LED driver is an external unit to the LCDs.

Table 2. Electrical characteristics

| Parameter | Symbol | Values | | | Unit | Notes |
|-------------------------------|-------------------------|--------|--------|--------|------|-------|
| | | Min | Typ | Max | | |
| MODULE : | | | | | | |
| Power Supply Input Voltage | V _{LCD} | 4.5 | 5.0 | 5.5 | Vdc | |
| Permissive Power Input Ripple | V _{LCD} | - | - | 0.4 | V | 2 |
| Power Supply Input Current | I _{LCD-MOSAIC} | - | (625) | (718) | mA | 1,3 |
| | I _{LCD-BLACK} | - | (694) | (798) | mA | 1,4 |
| | I _{LCD-L80} | - | (607) | (698) | mA | 1 |
| Power Consumption | P _{LCD} | - | (3.12) | (3.59) | Watt | 1,3 |
| Inrush current | I _{RUSH} | - | - | 3.5 | A | 1,5 |

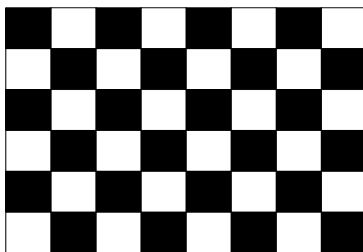
Note :

1. The specified characteristics perform under the $V_{LCD}=5.0V$, $25 \pm 2^{\circ}C$, $f_v=60Hz$ condition.
 f_v is the frame frequency.
2. Permissive Power Ripple should be measured under $V_{LCD}=5.0V$, $25 \pm 2^{\circ}C$,
 $f_v=75Hz$ condition and At that time,
we recommend the bandwidth configuration of oscilloscope is to be under 20MHz. (See FIG.3)
3. Mosaic pattern(8 x 6) is displayed.
4. Input current is specified at the maximum current pattern.
5. The duration of Inrush current is about 5ms and rising time of power Input is 500us \pm 20%.

FIG.3 pattern for Electrical characteristics

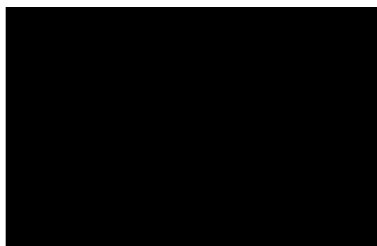
power consumption

White : 255Gray
Black : 0Gray



Mosaic Pattern(8 x 6)

power input ripple



Full Black Pattern

Energy star 5.0

White : 255Gray (80%)
Black : 0Gray (20%)



L80 Pattern

Product Specification

Table 3. LED array ELECTRICAL CHARACTERISTICS

| Parameter | Symbol | Condition | Values | | | Unit | Notes |
|--------------------|--------|-----------|--------|------|------|------|-------|
| | | | Min. | Typ. | Max. | | |
| LED String Current | Is | | - | 120 | 125 | mA | 1,2,5 |
| LED String Voltage | Vs | | 34.8 | 37.2 | 39.6 | V | 1,5 |
| Power Consumption | PBar | | - | 8.9 | 9.5 | Watt | 1,2,4 |
| LED Life Time | LED_LT | | 30,000 | - | - | Hrs | 3 |

Notes) The LED Bar consists of 24 LED packages, 2 strings (parallel) x 12 packages (serial)

LED driver design guide

- : The design of the LED driver must have specifications for the LED in LCD Assembly. The performance of the LED in LCM, for example life time or brightness, is extremely influenced by the characteristics of the LED driver.
- So all the parameters of an LED driver should be carefully designed and output current should be Constant current control.
- Please control feedback current of each string individually to compensate the current variation among the strings of LEDs.
- When you design or order the LED driver, please make sure unwanted lighting caused by the mismatch of the LED and the LED driver (no lighting, flicker, etc) never occurs.
- When you confirm it, the LCD module should be operated in the same condition as installed in your instrument.

Notes :

1. The specified values are for a single LED bar.
2. The specified current is defined as the input current for a single LED string with 100% duty cycle.
3. The LED life time is defined as the time when brightness of LED packages become 50% or less than the initial value under the conditions at $T_a = 25 \pm 2^\circ\text{C}$ and LED string current is typical value.
4. The power consumption shown above does not include loss of external driver.
The typical power consumption is calculated as $P_{\text{Bar}} = V_s(\text{Typ.}) \times I_s(\text{Typ.}) \times \text{No. of strings}$.
The maximum power consumption is calculated as $P_{\text{Bar}} = V_s(\text{Max.}) \times I_s(\text{Typ.}) \times \text{No. of strings}$.
5. LED operating conditions must not exceed Max. ratings.

Product Specification

3-2. Interface connections

3-2-1. LCD Module

LCD connector(CN1) : GT103-30S-HF15-E2500 (LSM) , UJU(IS100-L300-C23)

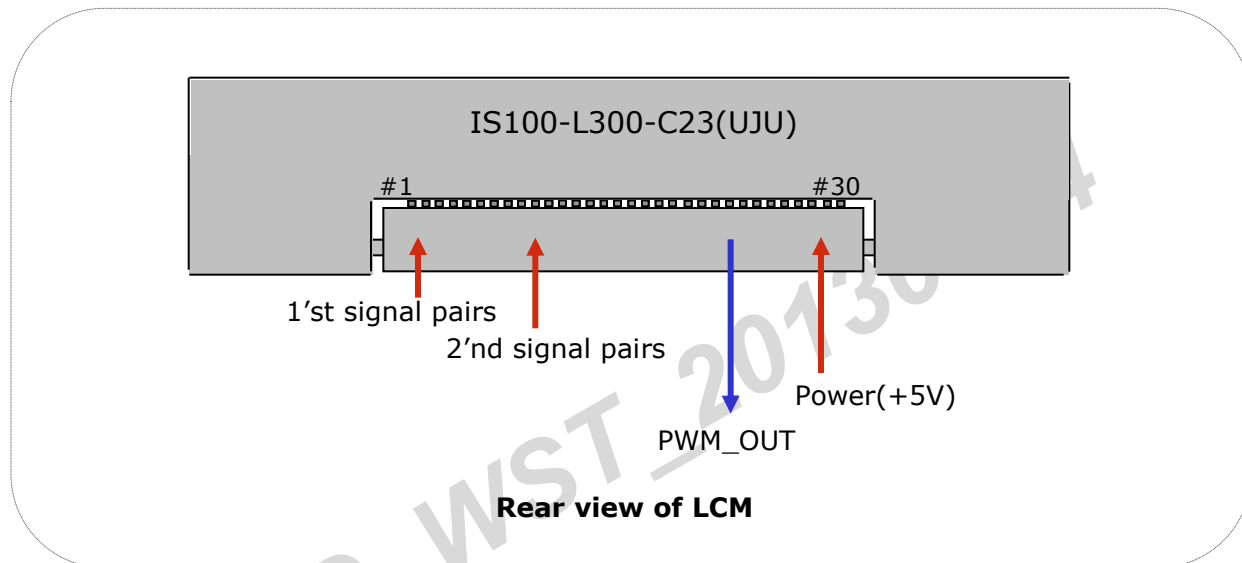
Mating connector : FI-X30H and FI-X30HL (JAE) or Equivalent

Table 4. Module connector(CN1) pin configuration

| Pin No | Symbol | Description |
|--------|---------|--|
| 1 | RX00- | Minus signal of 1st channel 0 (LVDS) |
| 2 | RX00+ | Plus signal of 1st channel 0 (LVDS) |
| 3 | RX01- | Minus signal of 1st channel 1 (LVDS) |
| 4 | RX01+ | Plus signal of 1st channel 1 (LVDS) |
| 5 | RX02- | Minus signal of 1st channel 2 (LVDS) |
| 6 | RX02+ | Plus signal of 1st channel 2 (LVDS) |
| 7 | GND | Ground(AGP) |
| 8 | RXOC- | Minus signal of 1st clock channel (LVDS) |
| 9 | RXOC+ | Plus signal of 1st clock channel (LVDS) |
| 10 | RX03- | Minus signal of 1st channel 3 (LVDS) |
| 11 | RX03+ | Plus signal of 1st channel 3 (LVDS) |
| 12 | RXE0- | Minus signal of 2nd channel 0 (LVDS) |
| 13 | RXE0+ | Plus signal of 2nd channel 0 (LVDS) |
| 14 | GND | Ground |
| 15 | RXE1- | Minus signal of 2nd channel 1 (LVDS) |
| 16 | RXE1+ | Plus signal of 2nd channel 1 (LVDS) |
| 17 | GND | Ground |
| 18 | RXE2- | Minus signal of 2nd channel 2 (LVDS) |
| 19 | RXE2+ | Plus signal of 2nd channel 2 (LVDS) |
| 20 | RXEC- | Minus signal of 2nd clock channel (LVDS) |
| 21 | RXEC+ | Plus signal of 2nd clock channel (LVDS) |
| 22 | RXE3- | Minus signal of 2nd channel 3 (LVDS) |
| 23 | RXE3+ | Plus signal of 2nd channel 3 (LVDS) |
| 24 | GND | Ground |
| 25 | NC | No Connection (For LCD internal use only.) |
| 26 | NC | No Connection (For LCD internal use only.) |
| 27 | PWM_OUT | Reference signal for inverter control |
| 28 | VLCD | Power Supply (5.0V) |
| 29 | VLCD | Power Supply (5.0V) |
| 30 | VLCD | Power Supply (5.0V) |

Product Specification

FIG. 4 Connector diagram



Note:

1. NC: No Connection.
2. All GND(ground) pins should be connected together and to Vss which should also be connected to the LCD's metal frame.
3. All V_{LCD} (power input) pins should be connected together.
4. Input Level of LVDS signal is based on the IEA 664 Standard.
5. PWM_OUT is a reference signal for inverter control.
This PWM signal is synchronized with vertical frequency.
Its frequency is 5 times of vertical frequency, and its duty ratio is 50%.
If the system don't use this pin, do not connect.

Product Specification

3-2-2. LED Interface

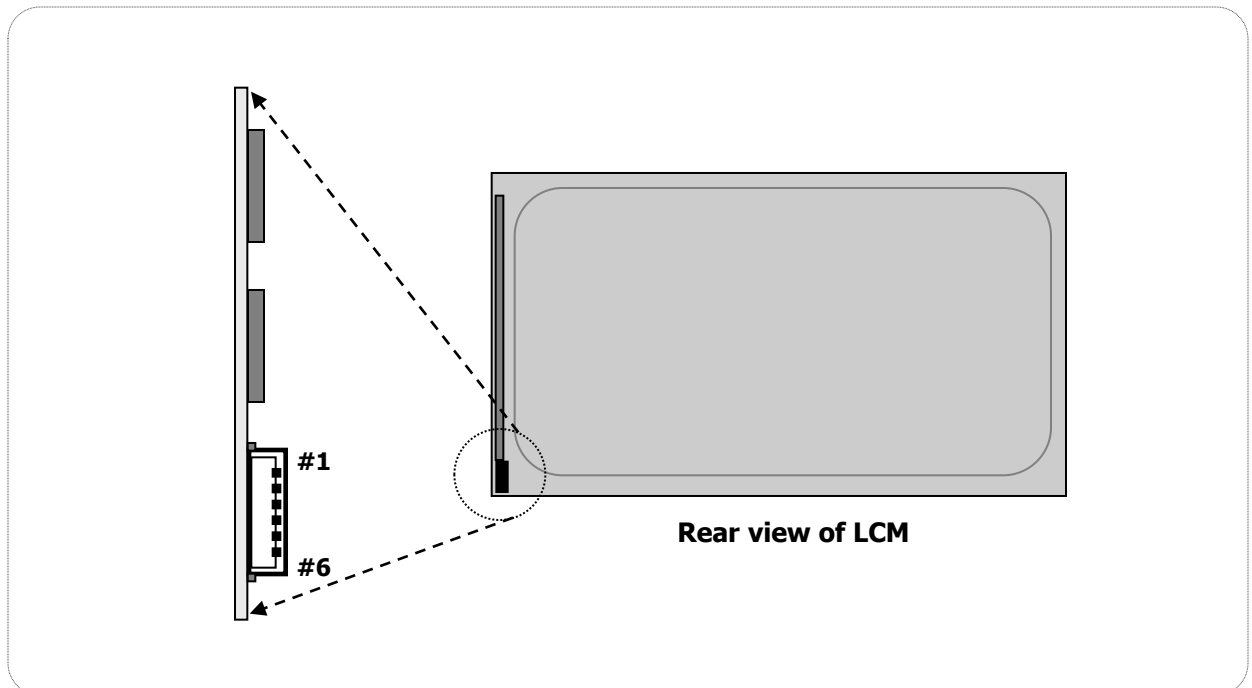
The LED interface connector is a model GT108-6P-H26-E3500, wire-locking type manufactured by LSM.

The mating connector is a SHJP-06V-S(HF) or SHJP-06V-A-K(HF) and Equivalent. The pin configuration for the connector is shown in the table below.

Table 5. BACKLIGHT CONNECTOR PIN CONFIGURATION(CN2)

| Pin | Symbol | Description | Notes |
|-----|--------|---------------------------|-------|
| 1 | FB1 | Channel1 Current Feedback | |
| 2 | NC | No connection | |
| 3 | VLED | LED Power Supply | |
| 4 | VLED | LED Power Supply | |
| 5 | NC | No connection | |
| 6 | FB2 | Channel2 Current Feedback | |

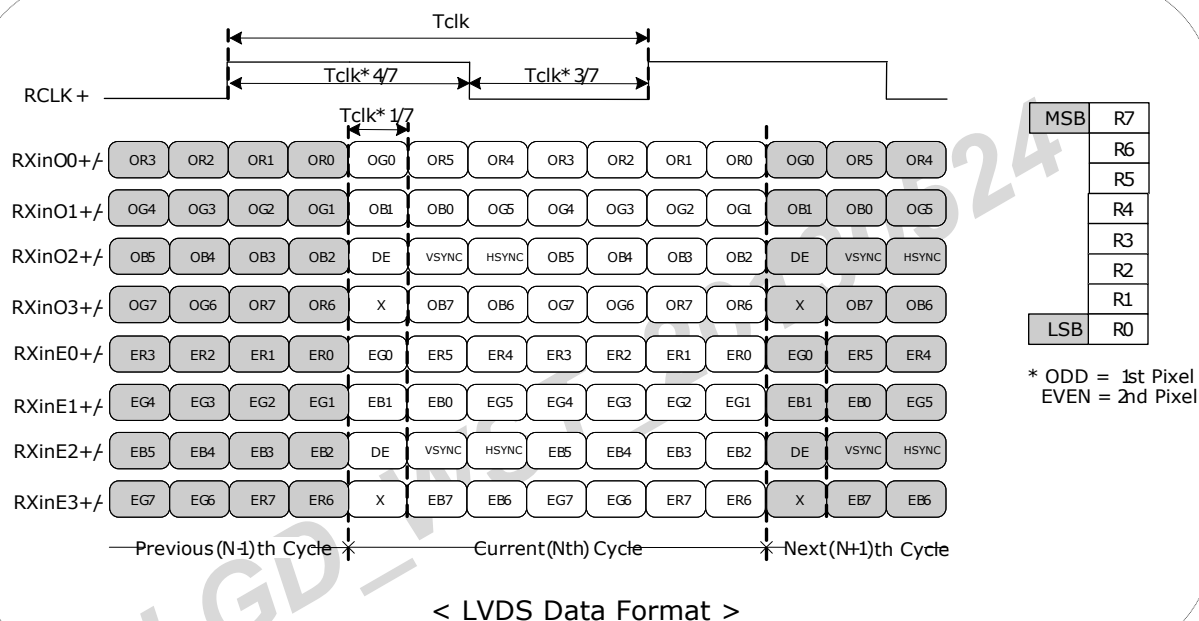
FIG. 5 Backlight connector view



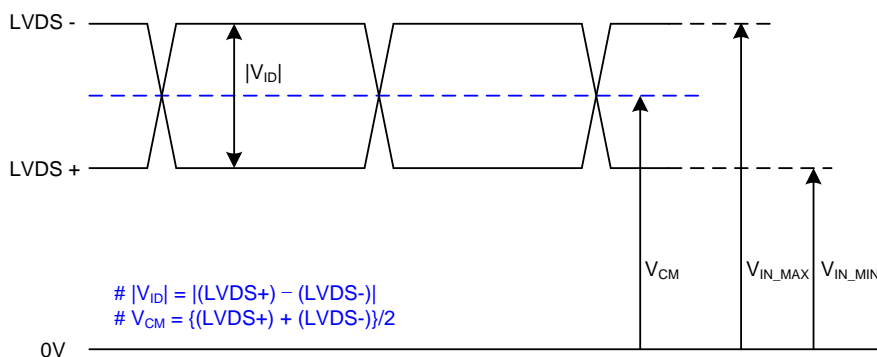
Product Specification

3-3. LVDS characteristics

3-3-1. LVDS Data format



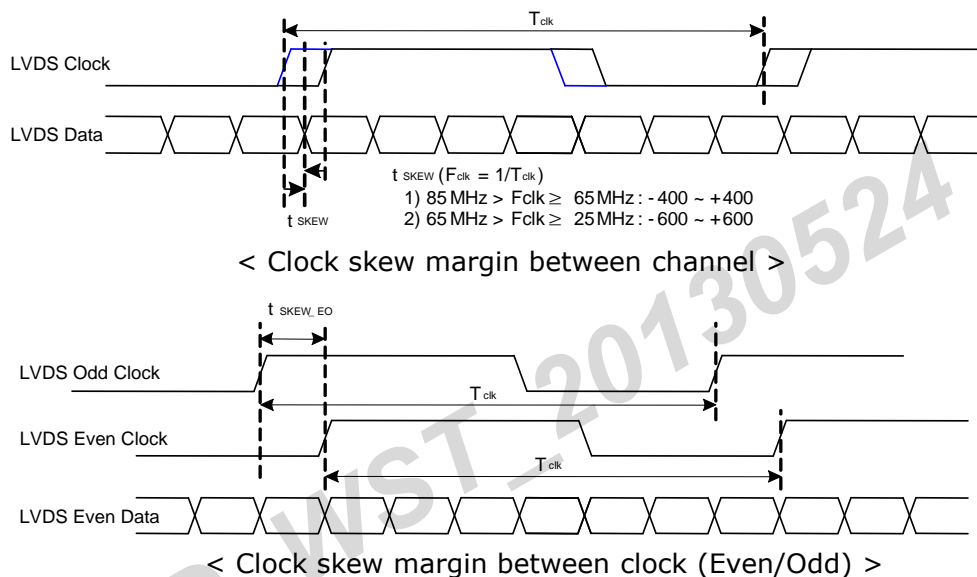
3-3-2. DC Specification



| Description | Symbol | Min | Max | Unit | Notes |
|---------------------------|------------|-----|-----|------|-------|
| LVDS Differential Voltage | $ V_{ID} $ | 200 | 600 | mV | - |
| LVDS Common mode Voltage | V_{CM} | 0.6 | 1.5 | V | - |
| LVDS Input Voltage Range | V_{IN} | 0.3 | 1.8 | V | - |

Product Specification

3-3-3. AC Specification



| Description | Symbol | Min | Max | Unit | Notes |
|---|----------------|-------|---------|-----------|--|
| LVDS Clock to Data Skew Margin | t_{SKEW} | - 400 | + 400 | ps | $85\text{MHz} > F_{clk} \geq 65\text{MHz}$ |
| | t_{SKEW} | - 600 | + 600 | ps | $65\text{MHz} > F_{clk} \geq 25\text{MHz}$ |
| Maximum deviation of input clock frequency during SSC | F_{DEV} | - | ± 3 | % | 1 |
| LVDS Clock to Clock Skew Margin (Even to Odd) | t_{SKEW_EO} | - 1/7 | + 1/7 | T_{clk} | - |

Note 1 :

This SSC specifications are just T-CON operation specification. In case of various system condition, the optimum setting value of SSC can be different. LGD recommend the SI should be adjust the SSC deviation and modulation frequency in order not to happen any kinds of defect phenomenon.

Product Specification

Table 6. Required signal assignment for Flat Link(NS:DS90CF383) transmitter

| Pin # | Pin Name | Require Signal | Pin # | Pin Name | Require Signal |
|-------|----------|----------------------------|-------|-------------------------|--|
| 1 | VCC | Power Supply for TTL Input | 29 | GND | Ground pin for TTL |
| 2 | D5 | TTL Input (R7) | 30 | D26 | TTL Input (DE) |
| 3 | D6 | TTL Input (R5) | 31 | T _x CLKIN | TTL Level clock Input |
| 4 | D7 | TTL Input (G0) | 32 | PWR DWN | Power Down Input |
| 5 | GND | Ground pin for TTL | 33 | PLL GND | Ground pin for PLL |
| 6 | D8 | TTL Input (G1) | 34 | PLL VCC | Power Supply for PLL |
| 7 | D9 | TTL Input (G2) | 35 | PLL GND | Ground pin for PLL |
| 8 | D10 | TTL Input (G6) | 36 | LVDS GND | Ground pin for LVDS |
| 9 | VCC | Power Supply for TTL Input | 37 | T _x OUT3 + | Positive LVDS differential data output 3 |
| 10 | D11 | TTL Input (G7) | 38 | T _x OUT3 – | Negative LVDS differential data output 3 |
| 11 | D12 | TTL Input (G3) | 39 | T _x CLKOUT + | Positive LVDS differential clock output |
| 12 | D13 | TTL Input (G4) | 40 | T _x CLKOUT – | Negative LVDS differential clock output |
| 13 | GND | Ground pin for TTL | 41 | T _x OUT2 + | Positive LVDS differential data output 2 |
| 14 | D14 | TTL Input (G5) | 42 | T _x OUT2 – | Negative LVDS differential data output 2 |
| 15 | D15 | TTL Input (B0) | 43 | LVDS GND | Ground pin for LVDS |
| 16 | D16 | TTL Input (B6) | 44 | LVDS VCC | Power Supply for LVDS |
| 17 | VCC | Power Supply for TTL Input | 45 | T _x OUT1 + | Positive LVDS differential data output 1 |
| 18 | D17 | TTL Input (B7) | 46 | T _x OUT1 – | Negative LVDS differential data output 1 |
| 19 | D18 | TTL Input (B1) | 47 | T _x OUT0 + | Positive LVDS differential data output 0 |
| 20 | D19 | TTL Input (B2) | 48 | T _x OUT0 – | Negative LVDS differential data output 0 |
| 21 | GND | Ground pin for TTL Input | 49 | LVDS GND | Ground pin for LVDS |
| 22 | D20 | TTL Input (B3) | 50 | D27 | TTL Input (R6) |
| 23 | D21 | TTL Input (B4) | 51 | D0 | TTL Input (R0) |
| 24 | D22 | TTL Input (B5) | 52 | D1 | TTL Input (R1) |
| 25 | D23 | TTL Input (RSVD) | 53 | GND | Ground pin for TTL |
| 26 | VCC | Power Supply for TTL Input | 54 | D2 | TTL Input (R2) |
| 27 | D24 | TTL Input (HSYNC) | 55 | D3 | TTL Input (R3) |
| 28 | D25 | TTL Input (VSYNC) | 56 | D4 | TTL Input (R4) |

Notes : Refer to LVDS Transmitter Data Sheet for detail descriptions.

Product Specification

3-4. Signal timing specifications

This is the signal timing required at the input of the User connector. All of the interface signal timing should be satisfied with the following specifications for it's proper operation.

Table 7. Timing table

| Parameter | | Symbol | Min. | Typ. | Max. | Unit | Notes |
|------------|------------------|-----------|------|------|------|-----------|-----------------------------------|
| D_{CLK} | Period | t_{CLK} | 14.6 | 18.5 | 23.1 | ns | Pixel frequency : Typ.108.0MHz |
| | Frequency | f_{CLK} | 43.2 | 54.0 | 68.4 | MHz | |
| Horizontal | Horizontal Valid | t_{HV} | 800 | 800 | 800 | t_{CLK} | |
| | H Period Total | t_{HP} | 856 | 900 | 1200 | | |
| | Hsync Frequency | f_H | 48.0 | 60.0 | 76.0 | | |
| Vertical | Vertical Valid | t_{VV} | 900 | 900 | 900 | t_{HP} | |
| | V Period Total | t_{VP} | 908 | 1000 | 1300 | | |
| | Vsync Frequency | f_V | 48 | 60 | 76 | | |

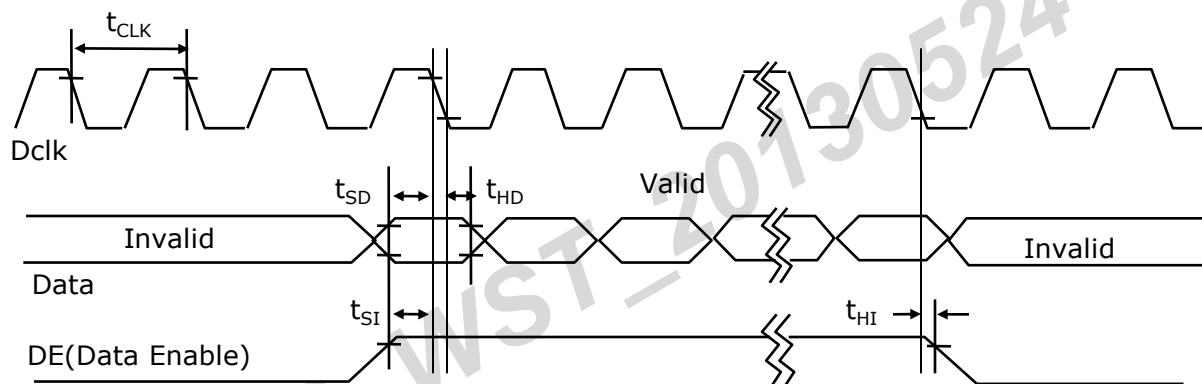
Note:

1. DE Only mode operation. The input of Hsync & Vsync signal does not have an effect on LCD normal operation.
2. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rates.
3. Horizontal period should be even.
4. Hsync Period, Hsync Width, and Horizontal Back Porch should be any times of of character number(4).

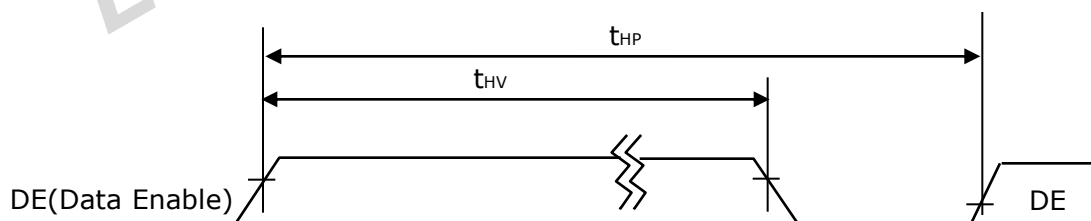
Product Specification

3-5. Signal timing waveforms

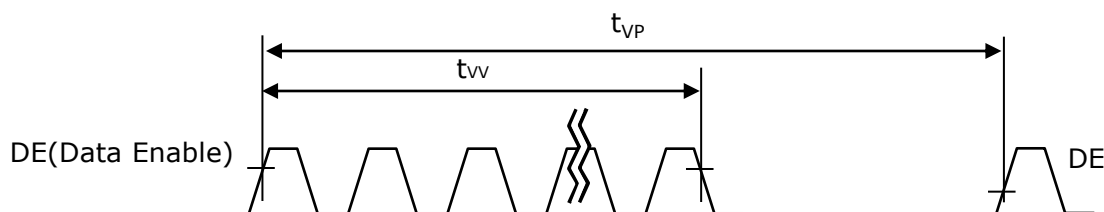
1. DCLK, DE, DATA waveforms



2. Horizontal waveform



3. Vertical waveform



Product Specification

3-6. Color input data reference

The brightness of each primary color (red, green and blue) is based on the 8bit gray scale data input for the color, the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

Table 8. Color data reference

| Color | | Input Color Data | | | | | | | | | | | | | | | | | | | | | | | |
|-------------|-------------------|------------------|----|----|----|-----|----|----|----|-------|----|----|----|-----|----|----|----|------|----|----|----|-----|----|----|----|
| | | Red | | | | | | | | Green | | | | | | | | Blue | | | | | | | |
| | | MSB | | | | LSB | | | | MSB | | | | LSB | | | | MSB | | | | LSB | | | |
| | | R7 | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Color | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red (255) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green (255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue (255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Red | Red(000) Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(001) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(002) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ----- | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | ----- | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Red(253) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(254) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(255) Bright | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Green | Green(000) Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(001) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(002) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ----- | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | ----- | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Green(253) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(255) Bright | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blue | Blue(000) Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue(001) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Blue(002) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| | ----- | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | ----- | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Blue(253) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| | Blue(254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue(255) Bright | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Product Specification

3-7. Power sequence

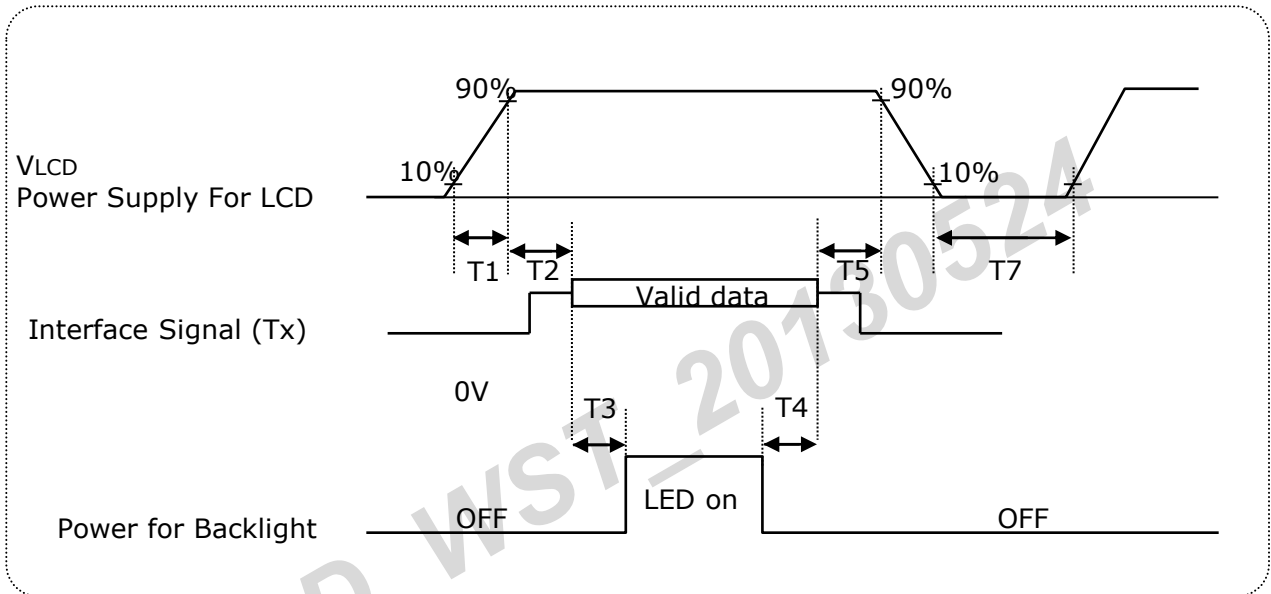


Table 9. Power sequence

| Parameter | Values | | | Units |
|-----------|--------|-----|-----|-------|
| | Min | Typ | Max | |
| T1 | 0.5 | - | 10 | ms |
| T2 | 0.01 | - | 50 | ms |
| T3 | 500 | - | - | ms |
| T4 | 200 | - | - | ms |
| T5 | 0.01 | - | 50 | ms |
| T7 | 1 | - | - | s |

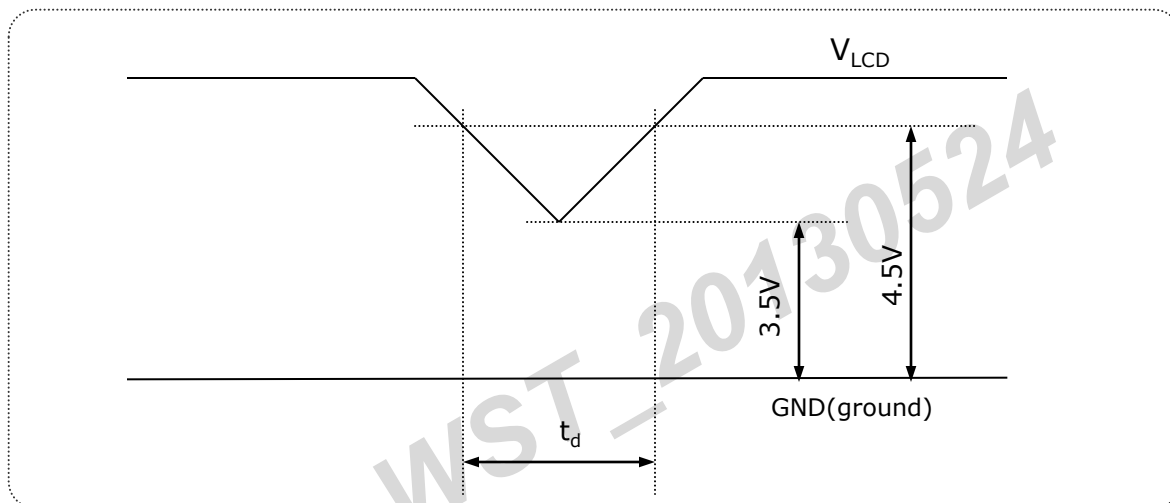
Notes :

1. Please avoid floating state of interface signal at invalid period.
2. When the interface signal is invalid, be sure to pull down the power supply for LCD V_{LCD} to 0V.
3. LED power must be turn on after power supply for LCD an interface signal are valid.

Product Specification

3-8. V_{LCD} Power dip condition

FIG. 6 Power dip condition



1) Dip condition

$$3.5V \leq V_{LCD} < 4.5V, \quad t_d \leq 20ms$$

2) $V_{LCD} < 3.5V$

V_{LCD} -dip conditions should also follow the Power On/Off conditions for supply voltage.

Product Specification

4. Optical specification

Optical characteristics are determined after the unit has been 'ON' for 30 minutes in a dark environment at 25°C.

Table 10. Optical characteristics

Ta= 25°C, V_{LCD}=5.0V, f_v=60Hz f_{CLK}=54.0MHz, I_{BL}=120mA

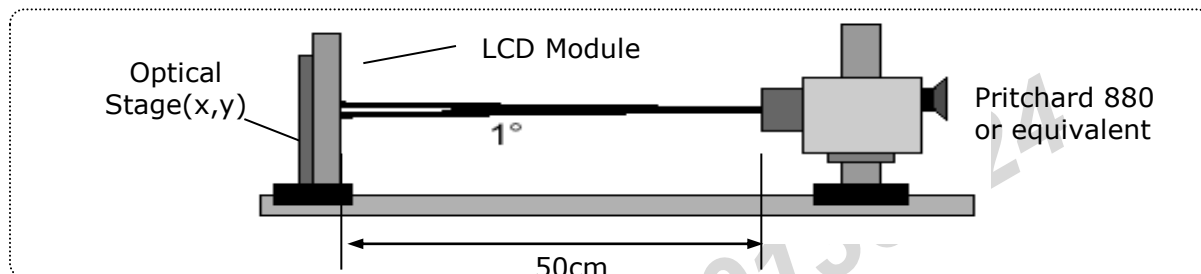
| Parameter | | Symbol | | Values | | | Units | Notes |
|--------------------------------|-----------------------|--------------------|----|--------------|---------|--------------|-------------------|---------------|
| | | | | Min | Typ | Max | | |
| Contrast Ratio | | CR | | 400 | 600 | - | | 1 (PR-880) |
| Surface Luminance, white | | L _{WH} | | 160 | 200 | - | cd/m ² | 2 (PR-880) |
| Luminance Variation | | δ _{WHITE} | 9P | 75 | - | - | % | 3 (PR-880) |
| Response Time | Rise Time | Tr _R | | - | (1.3) | (2.6) | ms | 4 (RD-80S) |
| | Decay Time | Tr _D | | - | (3.7) | (7.4) | ms | |
| Color Coordinates [CIE1931] | RED | Rx | | Typ -0.03 | (0.635) | Typ +0.03 | | (PR-650) |
| | | Ry | | | (0.339) | | | |
| | GREEN | Gx | | | (0.325) | | | |
| | | Gy | | | (0.629) | | | |
| | BLUE | Bx | | | (0.154) | | | |
| | | By | | | (0.054) | | | |
| | WHITE | Wx | | | 0.313 | | | |
| | | Wy | | | 0.329 | | | |
| Viewing Angle (CR>10) | | | | | | | | 5 (PR-880) |
| | x axis, right(φ=0°) | θ _r | | 40 | 45 | | Degree | |
| | x axis, left (φ=180°) | θ _l | | 40 | 45 | | | |
| | y axis, up (φ=90°) | θ _u | | 10 | 15 | | | |
| | y axis, down (φ=270°) | θ _d | | 30 | 35 | | | |
| Crosstalk | | | | | | 1.5 | % | 6 (PR-880) |
| Gamma | | | | | 2.2 | | | 7 |

Product Specification

The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0° .

FIG. 7 presents additional information concerning the measurement equipment and method.

FIG. 7 Optical characteristic measurement equipment and method



Notes :

1. Contrast ratio(CR) is defined mathematically as :It is measured at center point(1)

$$\text{Contrast ratio} = \frac{\text{Surface luminance with all white pixels}}{\text{Surface luminance with all black pixels}}$$

2. Surface luminance is the luminance value at center 1 point(1) across the LCD surface 50cm from the surface with all pixels displaying white.
For more information see FIG 8.

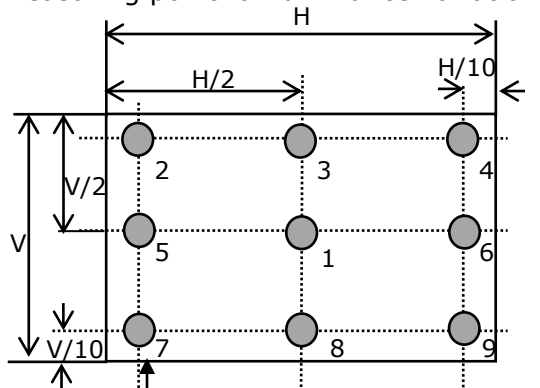
3. The variation in surface luminance , δ_{WHITE} is defined as

$$\delta_{\text{WHITE}} = \frac{\text{Minimum (P1,P2P9)}}{\text{Maximum (P1,P2P9)}} * 100$$

For more information see Figure 8.

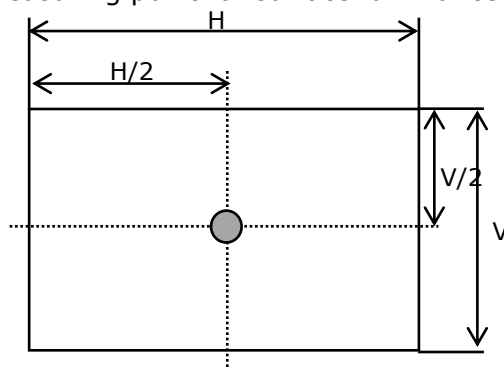
FIG. 8 Luminance measuring point

<Measuring point for luminance variation>



Active Area
H : 433.92 mm
V : 236.34 mm
@ H,V : Active Area

<Measuring point for surface luminance>



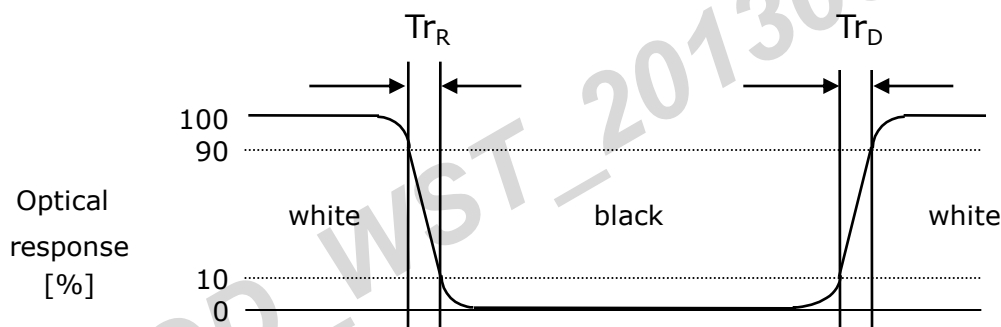
Product Specification

Notes :

- Response time is the time required for the display to transition from black to white (Decay Time, Tr_D) and from white to black (Rise Time, Tr_R)
The sampling rate is 500K sample/sec. For additional information see FIG. 9.

The response time is defined as the following figure and shall be measured by switching the input signal for each gray to gray.

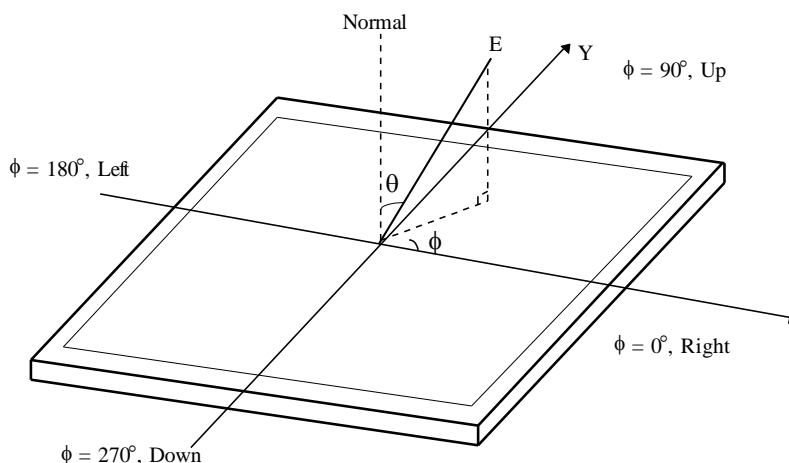
FIG. 9 Response time (measurement equipment : RD-80S)



- Viewing angle is the angle at which the contrast ratio is greater than 10 or 5. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG. 10 .

FIG. 10 Viewing angle

<Dimension of viewing angle range>



Product Specification

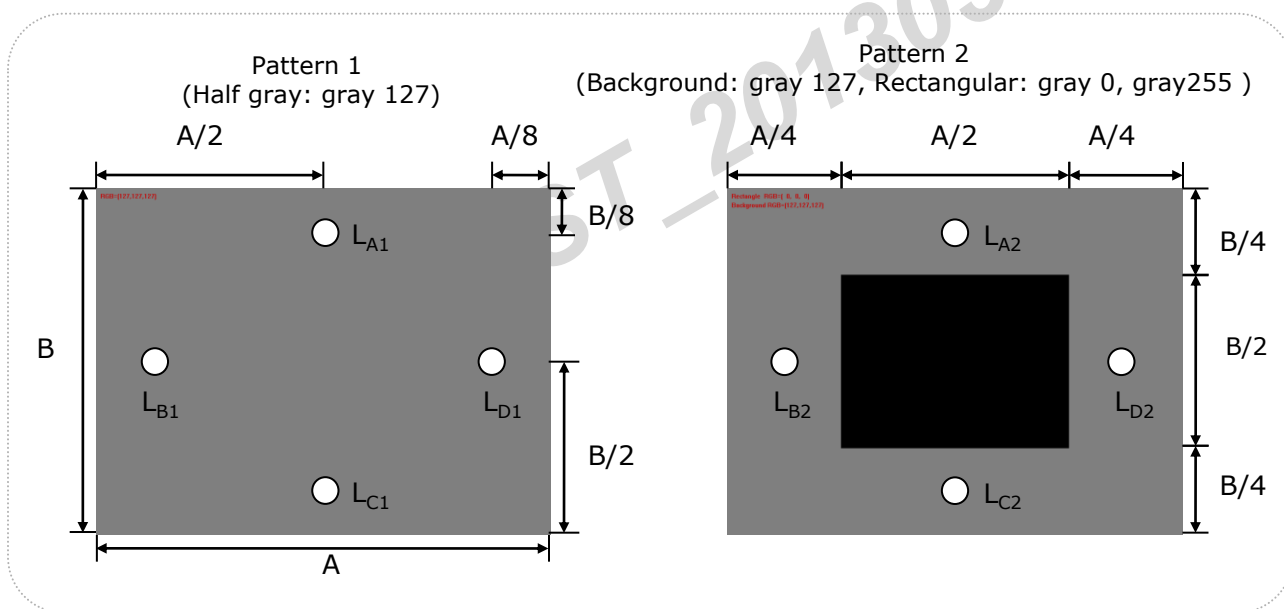
Notes :

6. Crosstalk is defined as

The equation of crosstalk : $(|L_{A[or C]2} - L_{A[or C]1}| / L_{A[or C]1}) \times 100(\%)$ [Vertical],
 $(|L_{B[or D]2} - L_{B[or D]1}| / L_{B[or D]1}) \times 100(\%)$ [Horizontal]

For more information see Figure 11.

FIG. 11 Crosstalk measuring point



7. Gamma Value is approximately 2.2. For more information see Table 11

Product Specification

Table 11.Gray Scale Specification

| Gray Level | Relative Luminance [%] (Typ.) |
|------------|-------------------------------|
| 0 | 0.1 |
| 15 | 0.26 |
| 31 | 1.01 |
| 47 | 2.48 |
| 63 | 4.72 |
| 79 | 7.66 |
| 95 | 11.36 |
| 111 | 15.86 |
| 127 | 21.38 |
| 143 | 28.33 |
| 159 | 36.70 |
| 175 | 46.66 |
| 191 | 58.37 |
| 207 | 70.94 |
| 223 | 82.08 |
| 239 | 92.13 |
| 255 | 100 |

Product Specification

5. Mechanical characteristics

The contents provide general mechanical characteristics. In addition the figures in the next page are detailed mechanical drawing of the LCD.

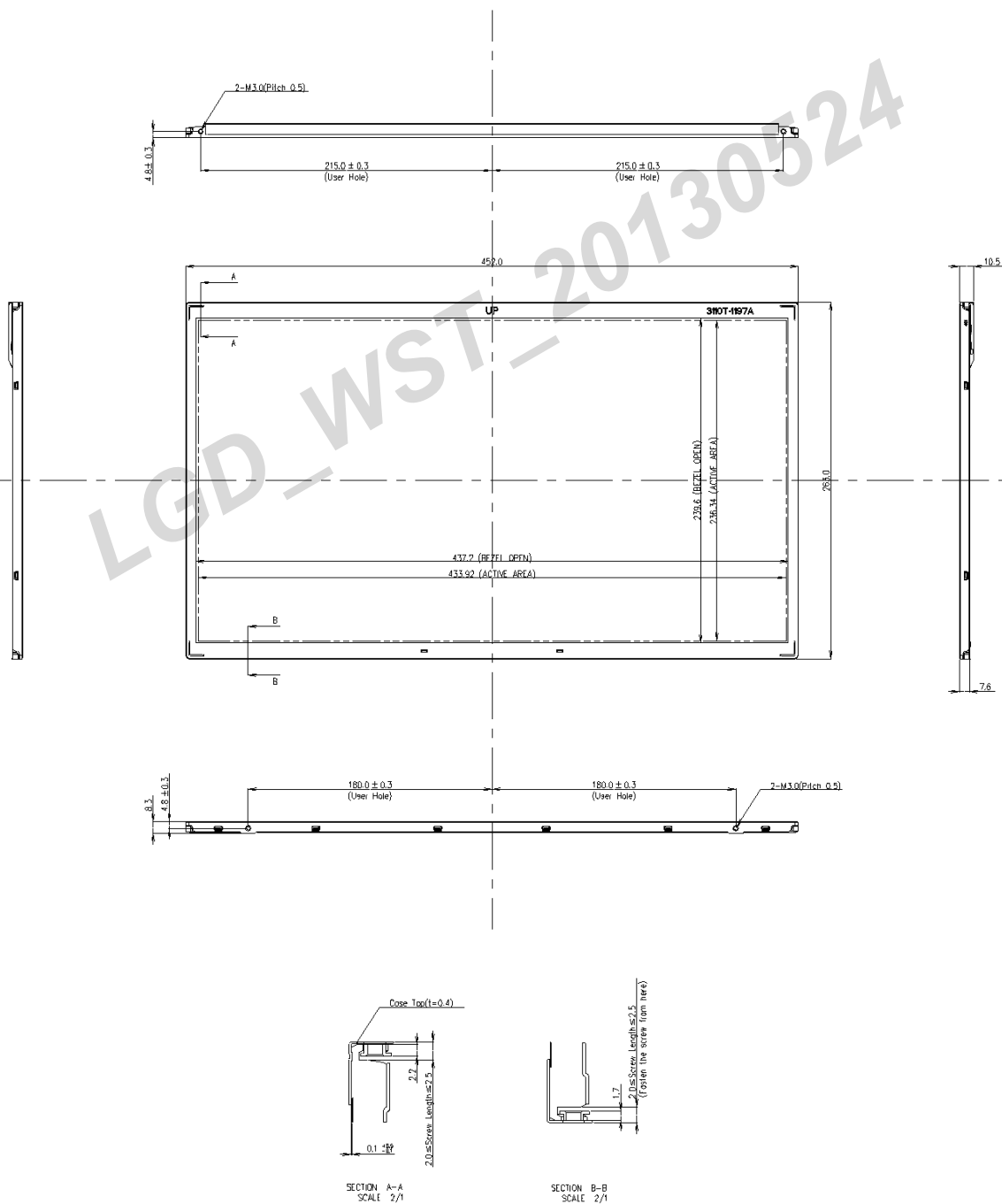
Table 12. Mechanical characteristics

| | | |
|---------------------|---|-----------|
| Outline dimension | Horizontal | 452.0 mm |
| | Vertical | 263.0 mm |
| | Depth | 10.5 mm |
| Bezel area | Horizontal | 437.2 mm |
| | Vertical | 239.6 mm |
| Active display area | Horizontal | 433.92 mm |
| | Vertical | 236.34 mm |
| Weight | 1,400g (Typ.), 1,470g (Max) | |
| Surface treatment | Hard coating(3H) Anti-glare treatment of the front polarizer | |

Notes : Please refer to a mechanic drawing in terms of tolerance at the next page.

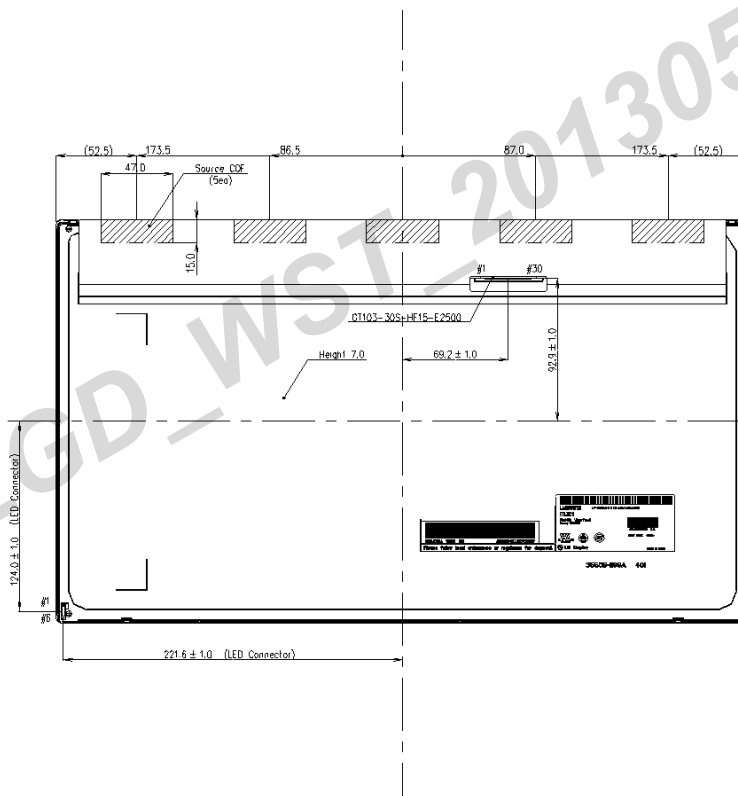
Product Specification

<FRONT VIEW>



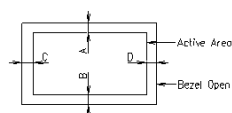
Product Specification

<REAR VIEW>



Notes

1. I/F Connector Specification : GT103-30S-HF15-E2500(LSM)
2. LED Connector specification
- JST, SM06B-SHLH(HF), 6PIN
3. Torque of user hole : 2.5~3.5 kgf-cm
4. Tilt and partial disposition tolerance of display area as following
 - (1) Y-Direction : IA-BI ≤ 1.0
 - (2) X-Direction : IC-DI ≤ 1.0



5. Unspecified tolerances to be ±0.5mm
6. The COF area is weak & sensitive. So, please don't press the COF area.

Product Specification

6. Reliability

Table 13. Environment test conditions

| No | Test Item | Condition |
|----|---|--|
| 1 | High temperature storage test | Ta= 60°C 240hrs |
| 2 | Low temperature storage test | Ta= -20°C 240hrs |
| 3 | High temperature operation test | Ta= 50°C 50%RH 240hrs |
| 4 | Low temperature operation test | Ta= 0°C 240hrs |
| 5 | Vibration test (non-operating) | Wave form : random Vibration level : 1.0GRMS Bandwidth : 10-300Hz Duration : X,Y,Z, 20 min One time each direction |
| 6 | Shock test (non-operating) | Shock level : 120G Waveform : half sine wave, 2msec Direction : $\pm X$, $\pm Y$, $\pm Z$ One time each direction |
| 7 | Altitude operating storage / shipment | 0 - 16,400 feet(5,000m) 0 - 40,000 feet(12,192m) |

{ Result evaluation criteria }

There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.

Product Specification

7. International Standards

7-1. Safety

- a) UL 60950-1, Underwriters Laboratories Inc.
Information Technology Equipment - Safety - Part 1 : General Requirements.
- b) CAN/CSA C22.2 No.60950-1-07, Canadian Standards Association.
Information Technology Equipment - Safety - Part 1 : General Requirements.
- c) EN 60950-1, European Committee for Electrotechnical Standardization (CENELEC).
Information Technology Equipment - Safety - Part 1 : General Requirements.
- d) IEC 60950-1, The International Electrotechnical Commission (IEC).
Information Technology Equipment - Safety - Part 1 : General Requirements.

Notes

- 1. Laser (LED Backlight) Information

| |
|---|
| Class 1M LED Product IEC60825-1 : 2001 Embedded LED Power (Class1M) |
|---|

- 2. Caution
: LED inside.
Class 1M laser (LEDs) radiation when open.
Do not open while operating.

7-2. EMC

- a) ANSI C63.4 "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."
American National Standards Institute (ANSI), 2003.
- b) CISPR 22 "Information technology equipment – Radio disturbance characteristics – Limit and methods of measurement." International Special Committee on Radio Interference (CISPR), 2005.
- c) CISPR 13 "Sound and television broadcast receivers and associated equipment – Radio disturbance characteristics – Limits and method of measurement."
International Special Committee on Radio Interference (CISPR), 2006.

7-3. Environment

- a) RoHS, Directive **2011/65/EC** of the European Parliament and of the council of **8 June 2011**

Product Specification

8. Packing

8-1. Designation of lot mark

a) Lot mark

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

A,B,C : Size (Inch)

E : Month

D : Year

F ~ M : Serial No.

Note:

1. Year

| | | | | | | | | | | |
|------|------|------|------|------|------|------|------|------|------|------|
| Year | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
| Mark | A | B | C | D | E | F | G | H | J | K |

2. Month

| | | | | | | | | | | | | |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Mark | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C |

b) Location of lot mark

Serial No. is printed on the label. The label is attached to the backside of the LCD module.
This is subject to change without prior notice.

8-2. Packing form

a) Package quantity in one box : TBD pcs(2 Modules are packed in 1 AL Bag.)

b) Box size : TBDmm x TBDmm X TBDmm

Product Specification

9. Precautions

Please pay attention to the followings when you use this TFT LCD module.

9-1. Mounting Precautions

- (1) You must mount a module using holes arranged in left & right sides.
- (2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the Module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- (3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to resist external force.
- (4) You should adopt radiation structure to satisfy the temperature specification.
- (5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- (6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth.
(Some cosmetics are detrimental to the polarizer.)
- (7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- (8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- (9) Do not open the case because inside circuits do not have sufficient strength.

9-2. Operating precautions

- (1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage : $V = \pm 200\text{mV}$ (Over and under shoot voltage)
- (2) Response time depends on the temperature. (In lower temperature, it becomes longer.)
- (3) Brightness depends on the temperature. (In Higher temperature, it becomes lower.)
And in lower temperature, response time (required time that brightness is stable after turned on) becomes longer.
- (4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- (5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
- (6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference.
- (7) Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can not be operated its full characteristics perfectly.
- (8) A screw which is fastened up the steels should be a machine screw (if not, it causes metal foreign material and deal LCM a fatal blow)
- (9) Please do not set LCD on its edge.

Product Specification**9-3. Electrostatic discharge control**

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

9-4. Precautions for strong light exposure

Strong light exposure causes degradation of polarizer and color filter.

9-5. Storage

When storing modules as spares for a long time, the following precautions are necessary.

- (1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- (2) The polarizer surface should not come in contact with any other object.
It is recommended that they be stored in the container in which they were shipped.

9-6. Handling precautions for protection film

- (1) The protection film is attached to the bezel with a small masking tape.
When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- (2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the bezel after the protection film is peeled off.
- (3) You can remove the glue easily. When the glue remains on the bezel surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.